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TRAINING AND DOCTRINE COMMAND

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STRATEGIC MOBILITY SENSITIVITY ANALYSIS OF SELECTED ALTERNATIVES
TACTICAL WHEELED VEHICLE FLEET STUDY

ACN 62072

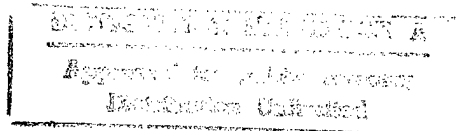
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FINAL REPORT

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DEPARTMENT OF THE ARMY
HEADQUARTERS UNITED STATES ARMY TRAINING AND DOCTRINE COMMAND
FORT MONROE, VIRGINIA 23651

24 April 1981

ATCD-AS

SUBJECT: Strategic Mobility Sensitivity Analysis of Selected Alternatives -
Tactical Wheeled Vehicle Fleet Study (TWVFS)

HQDA (DAMO-RQR)
WASH DC 20310

1. Reference: TWVFS Study Advisory Group (SAG) meeting held 4 Mar 81 at the Pentagon.
2. In accordance with minutes of referenced meeting, the final report is forwarded (Incl 1).
3. The report reflects the position of this command. While the analysis shows some small increases in the number of aircraft required to transport full divisions, the differences are inconsequential and do not warrant a change from Alternative 9 (5/4, 5, 10T trucks) as the TRADOC preferred procurement strategy for the Army.
4. It should be noted that the increase in number of aircraft required to transport the full Alternative 9 airmobile division, the division most likely to be airlifted, amounts to only 3.6% increase over Alternative 1 (base case) and 2.1% increase over Alternative 2 which retains the 2½T vehicle. These differences are offset by the increased cargo capacity of Alternative 9 and the fact that force tailoring would result in an actual airlift requirement different from that derived in this analysis.

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ACKNOWLEDGMENT

This analysis was initiated by Headquarters, Department of the Army, and was performed by the United States Army Transportation School at Fort Eustis, Virginia.

The conclusions and recommendations of this analysis are those of the Commandant of the Transportation School and are based on information gathered and analysis performed primarily by the U. S. Army Transportation School.

The Transportation School study team was headed by Major James P. Cargile. Members included CPT G. J. Broussard, CPT J. E. Lewis, and CPT R. J. Graebener.

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ABSTRACT

The analysis referenced in this report was an extension of the Tactical Wheeled Vehicle Fleet Study Phase I conducted in March-October 1980. The analysis investigated the impact of changes made in the U. S. Army's tactical wheeled vehicle fleet in terms of aircraft requirements needed to move U. S. Army units. The Military Traffic Management Command (MTMC) Air Scheduling and Loading Model (ASLM) was used to calculate aircraft sorties required to move a type Infantry Division, a Mechanized Infantry Division, an Airmobile Division, an Airborne Division, and a Corps Support Force closely tailored to the Airborne "D" Package. Aircraft sorties were calculated for each unit tailored to each of alternatives 1, 2, and 9 of the Tactical Wheeled Vehicle Fleet Study. A comparison was then made of sorties required to move the alternative 2 and 9 tailored forces against sorties required to move the corresponding alternative 1 (base case) tailored force.

The calculated number of aircraft sorties required for a strategic/intertheater deployment of the type units referenced in this analysis ranged from a low of 771 aircraft (691 C141B and 80 C5A) for the alternative 1 configured Airmobile Division to a high of 1491 aircraft (999 C141B and 492 C5A) for the alternative 9 configured Mechanized Infantry Division. In a strategic/intertheater air deployment, the impact of alternative 2 compared to alternative 1 ranged from a 1.4 percent increase in total aircraft for the Airmobile Division to a 4.3 percent increase in total aircraft for the Airborne Division. In a similar comparison between alternative 9 and alternative 1, the impact ranged from a 3.6 percent increase for the Airmobile Division to a 7.7 percent increase for the Infantry Division. The analysis indicates that aircraft sorties tend to increase as vehicle size increases; however, the actual extent of the increase is highly dependent upon the actual unit being deployed and the individual mission. In terms of strategic/intertheater air deployment, the alternative 2 configured force will in general require a small increase in total numbers of aircraft sorties as compared to alternative 1. The alternative 9 configured force will in general always require more aircraft than the alternative 2 configured force and even more so than an alternative 1 configured force. The conclusions of this analysis thus tend to favor alternative 2 over alternative 9.

CHAPTER 1

INTRODUCTION

1-1. PURPOSE. The purpose of this analysis was to determine whether or not the alternative tactical wheeled vehicle fleets favorably considered in the Tactical Wheeled Vehicle Fleet Study (ACN 62072) impact significantly on the number of aircraft sorties required to air deploy U. S. Army units.

1-2. BACKGROUND. Results of the Tactical Wheeled Vehicle Fleet Study indicated that the preferred U. S. Army tactical wheeled vehicle fleet would consist of 5/4-, 2.5-, 5-, and 10-ton trucks plus tractors and trailers. This vehicle and trailer mix describes alternative 2 of the basic study. Additionally, alternative 9 of the basic study, which, as an extension of alternative 2, also replaces 2.5-ton trucks with 5-ton trucks, was favorably considered over the other possible alternatives. Replacement of the 1/4-ton truck and 1/4-ton trailer with 5/4-ton payload vehicles may, because of variations in vehicle weights and dimensions, impact on the air deployability of infantry, airmobile, and airborne units by increasing or decreasing the number of aircraft sorties needed to air deploy those types of units. Additionally, the replacement of 2.5-ton trucks with 5-ton trucks suggests the possibility of an adverse impact in increased aircraft sorties needed to air deploy units equipped with a tactical wheeled vehicle fleet described by alternative 9 of the basic study. These uncertainties caused the Department of the Army to direct that a sensitivity analysis be conducted to determine the impact of alternatives 2 and 9 on air transportability of U. S. Army units in U. S. Air Force aircraft.

1-3. OBJECTIVES. This analysis was to accomplish the following objectives:

a. Determine the number of USAF aircraft sorties required to air deploy type U. S. Army units equipped with tactical wheeled vehicle fleets described by alternatives 1, 2, and 9 of the Tactical Wheeled Vehicle Fleet Study.

b. Determine whether fleet alternatives 2 and 9 impact significantly, as compared to fleet alternative 1 (base case), on the number of aircraft sorties required to air deploy type U. S. Army units equipped with tactical wheeled vehicles.

1-4. SCOPE.

a. The primary goal of this analysis was to isolate the impact on air transportability requirements due to vehicle changes resulting from reconfiguring the tactical wheeled vehicle fleet to a fleet described by alternatives 2 and 9. The alternative 1 configured force was the basis of comparison and was formed by applying programmed BOIP truck modifications to the force as currently documented in the USATRADOC automated table of organization and equipment (TOE) file. Units selected and included in this analysis were a type airmobile, infantry, mechanized infantry, and airborne

division, as well as a corps support force closely tailored to the Airborne "D" Package. Appendix B through Appendix F depict the alternative 1 (base case) configured subunits composing each of these forces. The "type" units were organized, manned, and equipped according to level 1 of the current "H" series TOE as depicted on USATRADOC's automated TOE file. Although generally representative of an active U. S. Army unit, the "type" units referenced in the study are not necessarily identical to a specific numbered unit. For example, the type airborne division used in the analysis was not the 82d Airborne Division which is organized under its own unique modified TOE.

b. Two combinations of USAF aircraft were considered in the analysis. Aircraft combination I, consisting of C130E (primary aircraft), C141B, and C5A aircraft, is representative of an aircraft mix that would typically be utilized in a tactical/intratheater deployment of U. S. Army units. Aircraft combination II, consisting of C141B (primary aircraft) and C5A aircraft, is representative of an aircraft mix that would typically be utilized in a strategic/intertheater deployment of U. S. Army units. It is important to note that the MTMC Air Scheduling and Loading Model (ASLM) initially identifies and loads all C5A required equipment on C5A aircraft, rounding out each load with C130E or C141B eligible equipment as required. This procedure insures that a minimum number of C5A loads are generated and that each C5A load is maximized as well as possible. Once this is accomplished, priority of loading of all remaining equipment goes to the smallest aircraft. In the case of aircraft combination II, this means that all remaining equipment is loaded on C141B aircraft; and in aircraft combination I, that all remaining C130E eligible equipment is loaded on C130E aircraft with the residual C141B required equipment loaded on C141B aircraft. Changes in aircraft combination I requirements thus provide insight into the impact of alternatives 2 and 9 in terms of aircraft sorties required for a tactical/intratheater deployment. In contrast, changes in aircraft combination II requirements provide insight into the impact of alternatives 2 and 9 relative to a strategic/intertheater deployment.

c. To isolate the impact due to changes in wheeled vehicles only, factors such as aircraft availability, time, and scenario which might affect the number of aircraft sorties required to move a particular force were held constant in the comparison of alternatives. A standard critical leg distance of 2,500 miles was used. This distance is within the capability of each aircraft and further defines the allowable cargo load (ACL) for each aircraft as follows:

<u>Aircraft</u>	<u>ACL</u>
C130E	37,000 lb
C141B	68,000 lb
C5A	167,000 lb

1-5. ASSUMPTIONS.

a. Additional assumptions that were made to reduce the impact of time and scenario are as follows:

- (1) Airfield capabilities do not restrict the type of aircraft being used.

(2) Vehicles are not stackable.

(3) All authorized TOE equipment accompanies the unit upon deployment.

(4) Additional 287 pounds (11.5 cu ft) of supplies per man accompanies the unit upon deployment.

(5) General cargo (TOE equipment and accompanying supplies) are loaded in organic cargo carriers, with residual being palletized on USAF 463L pallets.

(6) Excepting the DISCOM and DIVARTY, unit integrity is preserved down to battalion, separate company, and detachment level in both the loading of general cargo onto organic cargo carriers and in the actual loading of a unit's equipment onto the aircraft.

b. Assumption a(4) above was obtained from the Army Force Planning Data and Assumption Manual (AFPDA) and represents a summation of standard planning factors for Supply Classes I, II, III (Packaged), IV, V (Small Arms/60 Caliber and less), VI, VIII, and IX. To allow for a realistic loading of these accompanying supplies onto organic cargo carriers and 463L pallets, the parameter "287 lb" was converted to "11.5 ft³" utilizing weight-volume ratios given in FM 55-15, Transportation Reference Data.

CHAPTER 2

METHODOLOGY

2-1. GENERAL. A schematic diagram depicting the steps that were followed in calculating the number of sorties required to air deploy a specified force is shown in figure 2-1. It should be noted that the Military Traffic Management Command Transportation Engineering Agency (MTMCTEA) provided extensive modeling support in the completion of this analysis. The MTMC Air Scheduling and Loading Model (ASLM) was used to calculate numbers of aircraft sorties needed to move a specified force. A discussion of this model is presented in Appendix A. A Hewlett Packard 1000 Computer belonging to the Directorate of Combat Developments, USA Transportation School, Fort Eustis, Virginia, was also utilized in the analysis of results.

2-2. DATA BASE GENERATION. Automated unit equipment data files representing the unit being analyzed were generated utilizing the MTMC Transportability Analysis Reports Generator Unit Transportability Subsystem (TARGET). Figure 2-2 depicts in general how this is accomplished. The unit equipment file thus generated represents a collection of Army units equipped and manned at level 1 of their TOE's. These files represent validated equipment data from the US Army Forces Command (FORSCOM) Computerized Movement Planning and Status System (COMPASS) Equipment Characteristics Data File and from the MTMC Equipment Transportability Characteristics (MEC) Data File. Additionally, the VEHCAR subroutine (see figure 2-2) was utilized to load general cargo (nonvehicular TOE authorized equipment) and accompanying supplies onto organic cargo carriers. It should be noted that the VEHCAR subroutine utilizes data from the MEC Data file and exhausts the more critical of either the rated off-road weight capacity or the reduced configuration cubic capacity of each cargo carrier. Unit integrity is maintained in the loading of general cargo and accompanying supplies. The reader is referred to MTMC Pamphlet 18-7, Management Information Systems Transportability Analysis Reports Generator (TARGET) Unit-Transportability Subsystem for more detailed information on the TARGET system.

2-3. CONVERSION OF UNIT EQUIPMENT TO ALTERNATIVES 1, 2, AND 9. The alternative 1 configured force was the basis of comparison in the analysis and was formed by applying programmed BOIP truck modifications to the force as currently documented in the USATRADOC automated TOE file. Changes made to the unit equipment file to reflect the application of these truck modifications were as follows:

<u>Replace</u>	<u>With</u>
1 1/4-ton GAMA GOAT	High-Mobility Multipurpose Wheeled Vehicle (HMMWV)
1/2-ton MULE	HMMWV
8-ton GOER	10-ton HEMTT
TOW Section 1/4-ton JEEP (Truck TOW 1/4-ton, truck 1/4-ton, trailer 1/4-ton)	TOW Carrier HMMWV
TOW Section 1/2-ton MULE (Truck TOW MULE and 1/2-ton MULE)	TOW Carrier HMMWV

The unit equipment file thus modified became the basis for computing the number of aircraft sorties required to air deploy the alternative 1 configured force. In alternative 2, the unit equipment file was further modified by replacing the remaining 1/4-ton vehicles with 1 1/4-ton HMMWV or Commercial Utility Cargo Vehicle (CUCV) and deleting 1/4-ton trailers. Alternative 2 was modified to configure alternative 9 by replacing all 2.5 ton truck chassis vehicles with comparable 5-ton vehicles.

2-4. UNIT INTEGRITY.

a. Excepting the DISCOM and DIVARTY, unit integrity, down to battalion, separate company, and detachment level, was maintained in both the loading of general cargo/supplies onto organic cargo carriers and in the actual loading of equipment onto the aircraft. This was accomplished by subdividing the division-size force into battalions, companies, and detachments, and by treating each of these subelements as separate individual units. Appendix B through Appendix F depict the extent of unit integrity that was maintained for each force.

b. It should be noted that unit integrity in terms of the DISCOM and DIVARTY was maintained for the entire force. Specifically, no attempt was made to separate the DISCOM forward support company and assign it to a specific brigade. Nor was any attempt made to subdivide the DIVARTY batteries for tactical direct support of the forward brigades. It was considered possible that the division could deploy first to a staging area then redeploy to the final destination. In this case, the need to separate the forward support company out of the DISCOM would not be required until redeployment to the final destination. This approach was used consistently in calculating sortie requirements for each alternative.

2-5. CALCULATION OF AIRCRAFT REQUIREMENTS. The MTMC Air Scheduling and Loading Model was used to calculate the number of aircraft sorties needed to deploy each force configured to each alternative. This model is discussed in Appendix A. In calculating numbers of aircraft sorties required for alternatives 1, 2, and 9, the only changes that are made are the modifications to vehicles discussed in paragraph 2-3 above. Thus, the variation in aircraft sorties required for alternatives 2 and 9 as compared to alternative 1 is due entirely to the changes made in the tactical wheeled vehicles assigned to the force being analyzed. All other sources of sortie variation were held constant;

therefore, the results as stated in this analysis reflect the impact of reconfiguring the tactical wheeled vehicle fleet to a fleet described by alternatives 2 and 9.

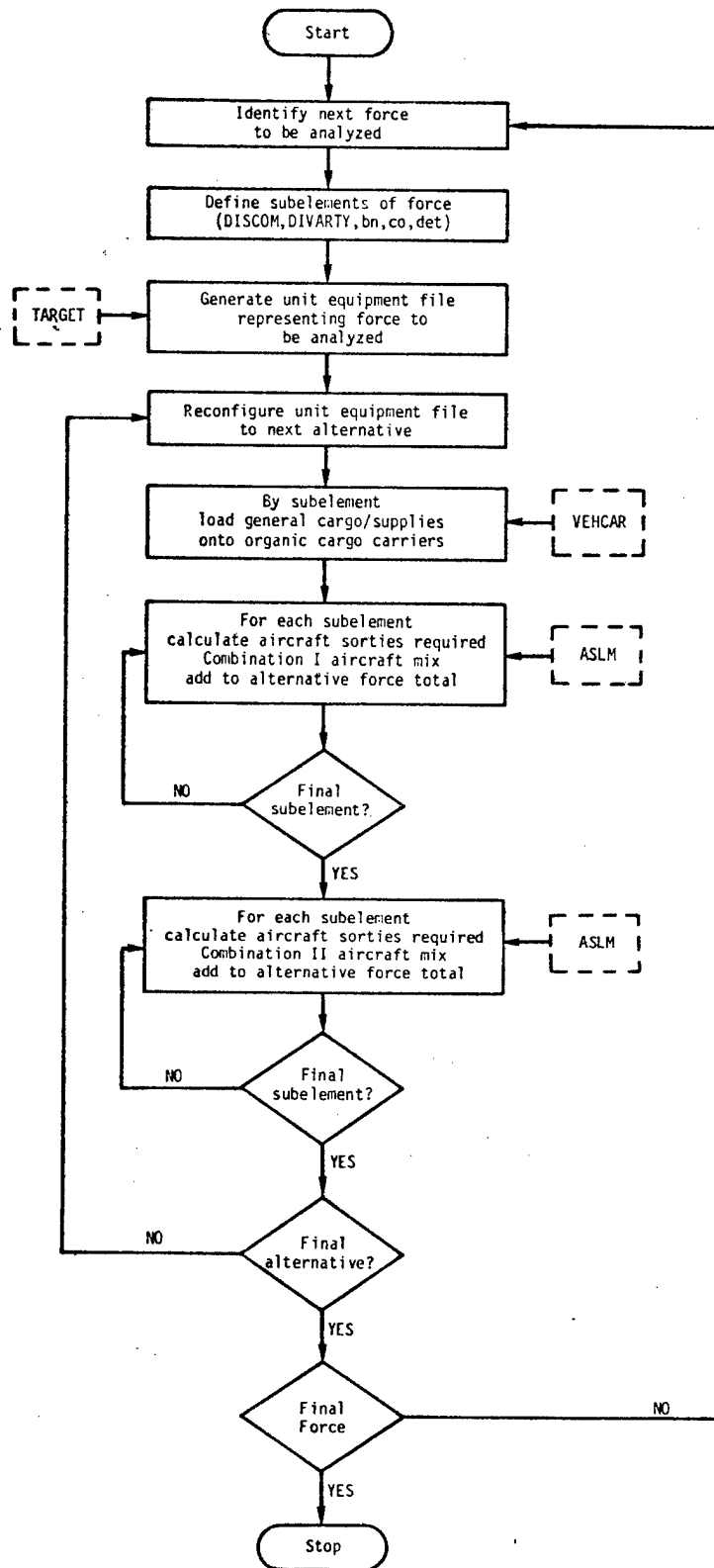


Figure 2-1. Methodology

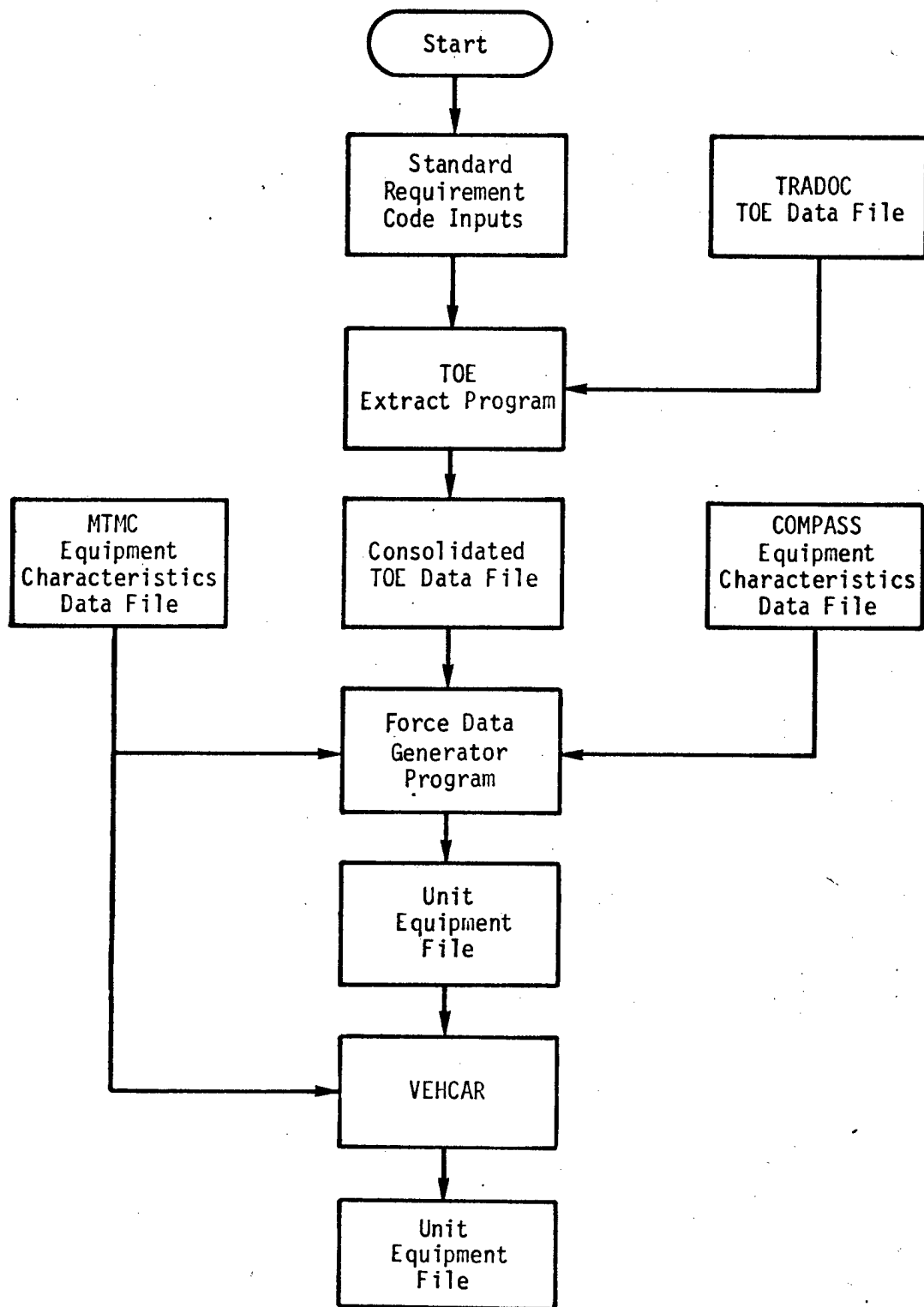


Figure 2-2. MTMC transportability analysis reports generator.

CHAPTER 3

RESULTS

3-1. AIRCRAFT REQUIREMENTS. The numbers of aircraft sorties required to air deploy each type force were calculated using the MTMC Air Scheduling and Loading Model. Using the methodology discussed in chapter 2, aircraft sorties were computed for each alternative of each type division and corps support force. Summaries of calculated aircraft sortie requirements are shown in tables 3-2 through 3-5. Table 3-2 summarizes the calculated combination I aircraft requirements by type for each alternative of each force. Table 3-3 consolidates the total calculated combination I aircraft requirements for each alternative of each force. In each of tables 3-2 and 3-3, the impact of vehicle changes resulting from tailoring the forces to alternatives 2 and 9 are given as percent increases/decreases compared to alternative 1. Tables 3-4 and 3-5 present similar information pertinent to calculated combination II aircraft requirements.

3-2. SUMMARY OBSERVATIONS. In observing tables 3-2 through 3-5, it should again be noted that the percent increases/decreases shown in parentheses are due entirely to variation caused by changes made to the tactical wheeled vehicles organic to each force. These changes were discussed in paragraph 2-3 and generally impact in the following manner:

a. Conversion from alternative 1 to alternative 2 replaced all 1/4 ton payload vehicles with 1 1/4 ton payload HMMWV or CUCV and deleted all remaining 1/4 ton cargo trailers. The majority of changes in this conversion was the one-for-two replacement of the 1/4 ton utility jeep and trailer with a 1 1/4 ton HMMWV or CUCV. To a lesser extent, the M718A1 1/4 ton ambulance was replaced with a HMMWV or CUCV 2-litter ambulance and the 1/4 ton utility jeep without trailer with the HMMWV or CUCV. The one-for-one replacement of the M718A1 and 1/4 ton jeep without trailer results in both an increased weight and cube and therefore tends to increase aircraft requirements. However, these vehicle-for-vehicle changes are greatly outweighed by the dominant one-for-two replacement of the 1/4 ton utility jeep and trailer with the HMMWV or CUCV. Introduction of the CUCV in the corps support force produces a net increase in both weight and cube and increased aircraft requirements should be anticipated regardless of aircraft combination. Introduction of the HMMWV in the divisional units produces a net increase in weight; however, the cube impact differs between the C130E and C141B. For the C130E, alternative 2 results in decreased cube capacity required to move the force. For the C141B, where floor width permits double row loading of the 1/4 ton trailer¹, the resulting impact is adverse since double row loading of the HMMWV is not possible. Therefore,

¹An analysis of C141B aircraft loads indicated that the 1/4 ton trailer was double row loaded by the air scheduling and loading model in the great majority of cases.

increased aircraft combination II requirements for all forces should be anticipated since conversion to alternative 2 produces increased weight and cube capacity required to move the force (C141B only). The observations shown in table 3-4 are consistent with this rationale.

The analysis of impact in aircraft combination I (C130E primary aircraft) requirements is somewhat more complex since conversion to alternative 2 produces increased weight but decreased cube in the units to be moved. Observations shown in table 3-2 indicate that alternative 2 impacts favorably in the airmobile and airborne divisions, but adversely in the infantry and mechanized infantry divisions. To gain insight into these varying impacts, the "footprint" of each force was compared with the "shoesize" of the C130E aircraft. We define "footprint" for force i and "shoesize" of the C130E as follows:

$$\text{footprint } i = \text{total ft}^2 (\text{equipment force } i) / \text{total STONS (equipment force } i)$$

$$i = 1, 2, \dots, 5$$

$$\text{shoesize (C130E)} = \text{total ft}^2 (\text{C130E}) / \text{ACL (C130E)}$$

Table 3-1 and figure 3-1 reflect the footprint of each force for alternatives 1 and 2. C130E outsized equipment was ignored in computing these footprints and both the cargo deck and loading ramp were considered in computing the shoesize of the C130E. Table 3-1 and figure 3-1 imply that the alternative 2 configured mechanized infantry division will, on the average, weigh out the C130E aircraft. In contrast, the other divisions and corps support force tend to cube out the C130E aircraft. Recall that for divisional units, the net impact of converting to alternative 2 was an increase in weight (adverse impact) but decrease in cube (favorable impact). Since the mechanized infantry division tends to weigh out the C130E aircraft, the adverse impact of increased weight is dominant and an increase in C130E requirements should be anticipated. In contrast, since the airmobile, infantry, and airborne divisions tend to cube out the C130E, the favorable impact of decreased cube dominates and decreases in C130E requirements should be anticipated. Increased C130E requirements should be anticipated for the corps support force since the introduction of the CUCV produces both increased cube and weight. Excepting the infantry division, observations in table 3-2 are consistent with this rationale.

Further analysis of the infantry division indicated that the peculiar composition of some of the division's sub-elements produced adverse impacts in C130E requirements in going from alternative 1 to alternative 2. The alternative 2 configured engineer battalion, for example, required a 9.2 percent increase in C130E aircraft as compared to alternative 1. Adverse impacts were also produced by the division support command and by each of the eight infantry battalions. Small footprints and rounding out of C5A loads tended to increase C130E aircraft requirements and to negate any favorable impact that might have been anticipated.

b. Conversion of alternative 2 to alternative 9 replaced all 2 1/2 ton truck chassis vehicles with comparable 5 ton vehicles. Both increased weight and cube result from this conversion; therefore, increased aircraft requirements (both combinations) should be anticipated. Observations shown in tables 3-2 and 3-4 are consistent with this rationale.

3-3. SUMMARY RESULTS:

a. Tables 3-2 and 3-3 show the number of aircraft sorties required to move each alternative of each type force with a combination I (C130E primary aircraft) mix of aircraft. In terms of total numbers and considering only divisional units, the total calculated sorties ranged from a low of 1,786 for the alternative 2 configured airmobile division to a high of 2,672 for the alternative 9 configured mechanized infantry division. The impact of alternative 2, compared to alternative 1, ranged from a 2.2 percent decrease for the airmobile division to a .8 percent increase for the infantry division. In a similar comparison of alternative 9 to alternative 1, the impact ranged from a .9 percent decrease for the airmobile division to a 4.1 percent increase for the infantry division. The results indicate different trends between division types and between alternatives. In every case, the alternative 9 configured force required more aircraft sorties than the alternative 2 configured force.

b. Tables 3-4 and 3-5 show the number of aircraft sorties required to move each alternative of each type force, with a combination II (C141B primary aircraft) mix of aircraft. In terms of total numbers and considering only divisional units, the total calculated sorties ranged from a low of 771 for the alternative 1 configured airmobile division to a high of 1,491 for the alternative 9 configured mechanized infantry division. The impact of alternative 2, compared to alternative 1, ranged from a 1.4 percent increase for the airmobile division to a 4.3 percent increase for the airborne division. In a similar comparison of alternative 9 to alternative 1, the impact ranged from a 3.6 percent increase for the airmobile division to a 7.7 percent increase for the infantry division. Different trends again appear between division types and alternatives. Again, the alternative 9 configured force required more aircraft sorties than the alternative 2 configured force.

3-4. CONCLUSIONS.

a. It is likely that a greater strategic lift capability will be required to transport U.S. Army units configured vehicle-wise to alternative 2 of the Tactical Wheeled Vehicle Fleet Study.

b. It is likely that a greater strategic lift capability will be required to transport U.S. Army units configured vehicle-wise to alternative 9 of the Tactical Wheeled Vehicle Fleet Study.

c. It is likely that a greater tactical lift capability will be required to transport U.S. Army units configured vehicle-wise to alternative 9 of the Tactical Wheeled Vehicle Fleet Study.

d. The impact on tactical lift aircraft requirements due to conversion of the existing tactical wheeled vehicle fleet to an alternative 2 configured fleet may be favorable or unfavorable depending on the actual equipment composition of the units being moved.

e. A tactical wheeled vehicle fleet configured to alternative 9 is likely to require more strategic and tactical airlift support than a tactical wheeled vehicle fleet configured to alternative 2.

3-5. CLOSING NOTE. It is important that the reader of this report view the conclusions above as they were intended. Specifically, no attempt is made to define aircraft lift requirements needed to move a specific force on a specific mission. Conclusions are based and stated in the context of changes in aircraft requirements resulting from tailoring the tactical wheeled vehicle fleet to one described by alternatives 1, 2, and 9 of the Tactical Wheeled Vehicle Fleet Study. Conclusions, as stated, are fully supported by the data shown in tables 3-2 through 3-5. The methodology discussed in chapter 2 of this report utilizes consistent logic in generating aircraft loads for each alternative of each force. The loading of each alternative of each force in this manner insures that the changes reflected, as percent increases/decreases in tables 3-2 through 3-5, are, in fact, due entirely to variation caused by vehicle changes described in paragraph 2-3. These changes provide credible insight into the real impact of alternatives 2 and 9 on aircraft lift requirements needed to tactically deploy or strategically deploy a force.

Table 3-1. Footprints (ft²/STON)*

	<u>ALT 1</u>	<u>ALT 2</u>
Airmobile Division	28.4	27.3
Infantry Division	27.1	25.5
Mech Inf Division	22.8	21.9
Airborne Division	27.5	25.4
Corps Spt Force	25.5	26.1

Shoesize (C130E) = 22.3

*Footprints were calculated based on C130E eligible equipment only. Shoesize of C130E includes cargo deck and 120 inch loading ramp.

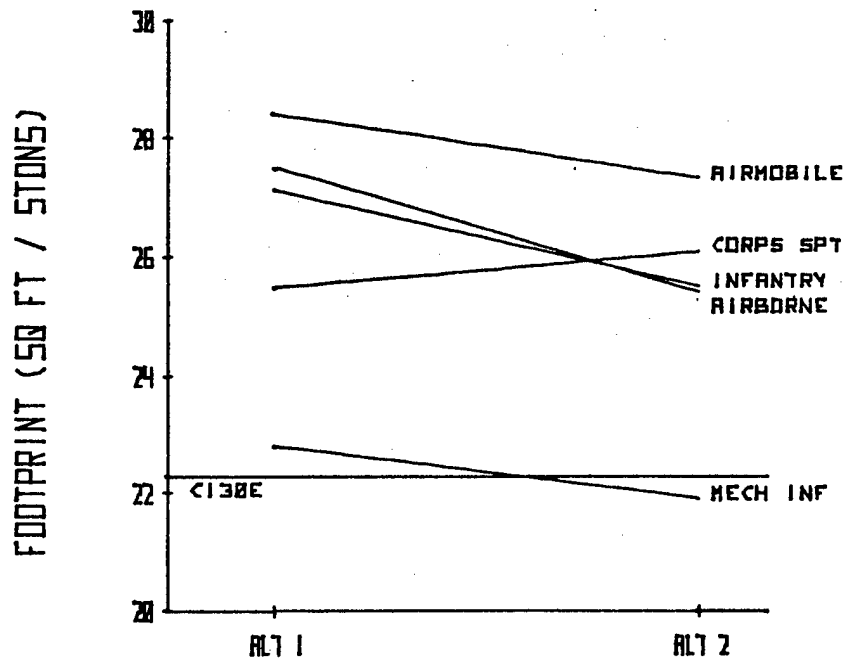


Figure 3-1. Footprints versus alternatives

Table 3-2. Summary A/C Requirements Combination I (C130E, C141B, C5A)
(% Increase/Decrease as Compared to Alternative 1)

	<u>C130E</u>	<u>ALT 1 C141B</u>	<u>C5A</u>	<u>C130E</u>	<u>ALT 2 C141B</u>	<u>C5A</u>	<u>C130E</u>	<u>ALT 9 C141B</u>	<u>C5A</u>
Airmobile Division	1739	11	76	1699 (-2.3)	11	76	1721 (-1.0)	11	77 (+1.3)
Infantry Division	2206	16	177	2225 (+.9)	16	177	2303 (+4.4)	16	179 (+1.1)
Mech Inf Division	2115	23	488	2119 (+.2)	23	488	2157 (+2.0)	23	492 (+.8)
Airborne Division	1917	32	36	1890 (-1.4)	32	36	1922 (+.3)	32	36
Corps Spt Force	2914	87	176	2961 (+1.6)	87	176	3047 (+4.6)	81 (-6.9)	180 (+2.3)

Table 3-3. Consolidated A/C Requirements Combination I (C130E + C141B + C5A)
(% Increase/Decrease as Compared to Alternative 1)

	<u>ALT 1</u>	<u>ALT 2</u>	<u>ALT 3</u>
Airmobile Division	1826	1786 (-2.2)	1809 (-.9)
Infantry Division	2399	2418 (.8)	2498 (4.1)
Mech Inf Division	2626	2630 (.2)	2672 (1.8)
Airborne Division	1985	1958 (-1.4)	1990 (.3)
Corps Spt Force	3177	3224 (1.5)	3308 (4.1)

Table 3-4. Summary A/C Requirements Combination II (C141B, C5A)
(% Increase/Decrease as Compared to Alternative 1)

	ALT 1		ALT 2		ALT 3	
	<u>C141B</u>	<u>C5A</u>	<u>C141B</u>	<u>C5A</u>	<u>C141B</u>	<u>C5A</u>
Airmobile Division	691	80	702 (+1.6)	80	718 (+3.9)	81 (+1.3)
Infantry Division	928	177	969 (+4.4)	177	1011 (+8.9)	179 (+1.1)
Mech Inf Division	906	488	953 (+5.2)	488	999 (+10.3)	492 (+.8)
Airborne Division	796	37	832 (+4.5)	37	843 (+5.9)	37
Corps Spt Force	1263	183	1307 (+3.5)	183	1352 (+7.0)	187 (+2.2)

Table 3-5. Consolidated A/C Requirements Combination II (C141B + C5A)
(% Increase/Decrease as Compared to Alternative 1)

	<u>ALT 1</u>	<u>ALT 2</u>	<u>ALT 3</u>
Airmobile Division	771	782 (1.4)	799 (3.6)
Infantry Division	1105	1146 (3.7)	1190 (7.7)
Mech Inf Division	1394	1441 (3.4)	1491 (7.0)
Airborne Division	833	869 (4.3)	880 (5.6)
Corps Spt Force	1446	1490 (3.0)	1539 (6.4)

APPENDIX A

MTMC AIR SCHEDULING AND LOADING MODEL

A-1. PURPOSE. This appendix provides an overview of the Military Traffic Management Command Air Scheduling and Loading Model (ASLM). The ASLM is a computer-based, deterministic model operating on user-specified forces for which equipment and personnel data are generated by the MTMC TARGET System. Given the TARGET-generated data on such a force, ASLM nominates aircraft models to move the equipment based on user input priorities. It then performs a detailed geometric loading of the aircraft.

A-2. GENERAL. ASLM differs from other air-loading models available in two main respects. First, it is driven by highly detailed and validated equipment data from the US Army Forces Command (FORSCOM) Computerized Movement Planning and Status System (COMPASS) equipment characteristics data file and from the MTMC air certification data file.¹ Second, aircraft loading is based on simple, rapidly computed algorithms. Loading is accomplished using a straightforward geometric technique which does not consider center of gravity location. In real-world loading, the equipment that is loaded on a specific aircraft can almost always be shifted around within the aircraft to satisfy center of gravity limitations.

A-3. SYSTEM ACCESS. ASLM is programed in FORTRAN for the Honeywell 6000 series of computers, and is resident on the H6060 system at HQ MTMC. Access is normally made through the H6060 time-sharing/batch interface. Execution of the programs of ASLM requires that the user first execute the data retrieval programs of the TARGET system for the force of interest. Figure A-1 depicts a schematic of the steps performed by ASLM in calculating sortie requirements.

¹These files are published as TB 55-46-1, Standard Characteristics (Dimensions, Weight and Cube) for Transportability of Military Vehicles and Other Outsize/Overweight Equipment, and TB 55-45/AFP 76-19, Certification of Military Equipment for Transport in MAC/CRAF Aircraft.

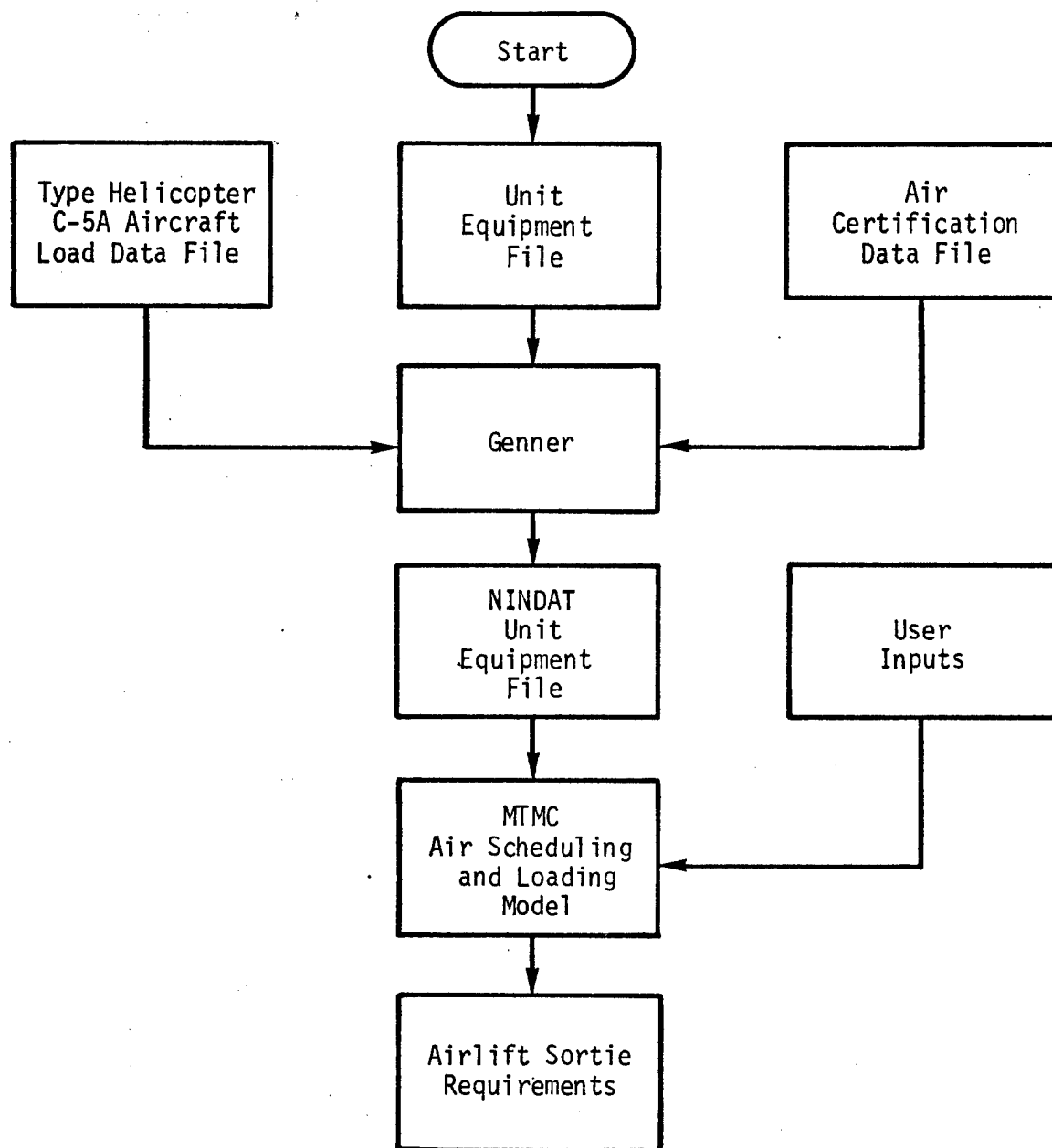


Figure A-1. Air scheduling and loading model.

A-4. AIRCRAFT MODELS. Figure A-2 shows the general model used by ASLM to depict the aircraft cargo compartment cross section.

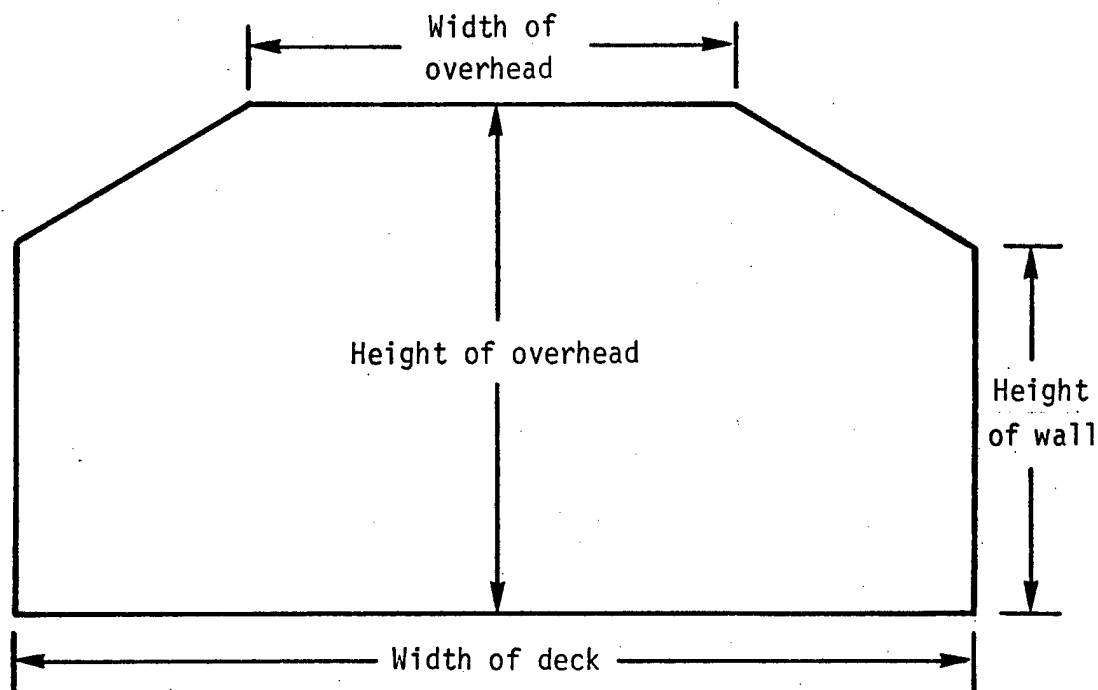


Figure A-2. Aircraft cargo compartment cross section.

Specific dimensions for the aircraft used in this analysis are as follows:

Cargo Compartment Dimensions (inches)

<u>AIRCRAFT</u>	<u>Width Overhead</u>	<u>Width Deck</u>	<u>Height Wall</u>	<u>Height Overhead</u>	<u>Length Deck</u>
C130E	99	99	102	102	480
C141B	123	123	103	103	1090
C5A	144	216	114	156	1453

A-5. EXAMPLE. The following example depicts the loading of a unit's equipment by ASLM. We will assume that the C141B is the priority aircraft and that the TARGET-generated data for the unit is as follows:

Force Equipment Summary

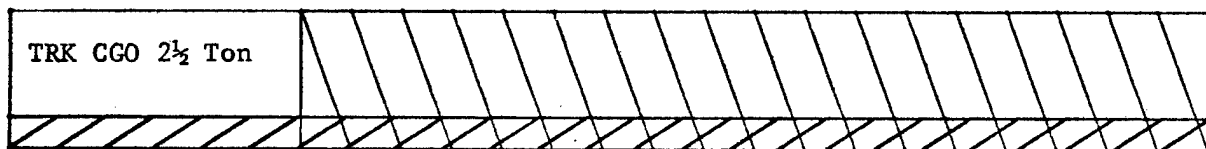
<u>LIN</u>	<u>Nomenclature</u>	<u>Quantity</u>	<u>Length</u>	<u>Width</u>	<u>Height</u>	<u>Weight</u>
X60833	Truck 1/4-ton	3	131.5	64	52.5	2450
W95400	TRL CGO 1/4-ton	3	108.5	61.5	44	580
X40009	TRK 2.5-ton	1	264.8	95.4	88.4	13180
W95811	TRL CGO 1.5-ton	1	166	83	82	2670

The first thing ASLM does is to sort the equipment by length, thus resulting in the following:

Sorted Force Equipment Summary

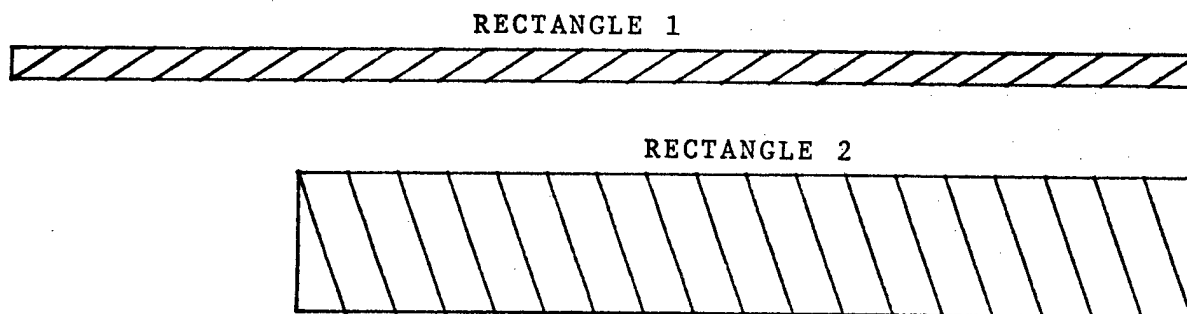
<u>LIN</u>	<u>Nomenclature</u>	<u>Quantity</u>	<u>Length</u>	<u>Width</u>	<u>Height</u>	<u>Weight</u>
X40009	TRK 2.5-ton	1	264.8	95.4	88.4	13180
W95811	TRL CGO 1.5-ton	1	166	83	82	2670
X60833	TRK 1/4-ton	3	131.5	64	52.5	2450
W95400	TRL CGO 1/4-ton	3	108.5	61.5	44	580

The model first checks each item of equipment against the Air Certification Data File to determine if there are any outsized items of equipment. Equipment that is outsized for the C141B is loaded on the C5A (or classified as non-air-transportable if outsized for C5A) and the C5A is then fully loaded with other unit equipment. In this example, all equipment is certified as being transportable in the C141B and therefore no C5A will be scheduled. ASLM nominates a C141B aircraft and loads the first item of equipment on it (TRK CGO 2 1/2 TON). ASLM will then check all remaining items of equipment for a possible double row load parallel to the TRK CGO 2 1/2 TON. In this case, no equipment can be loaded side by side (double row) with the TRK CGO 2 1/2 TON and the load for this 1st iteration is depicted as follows:

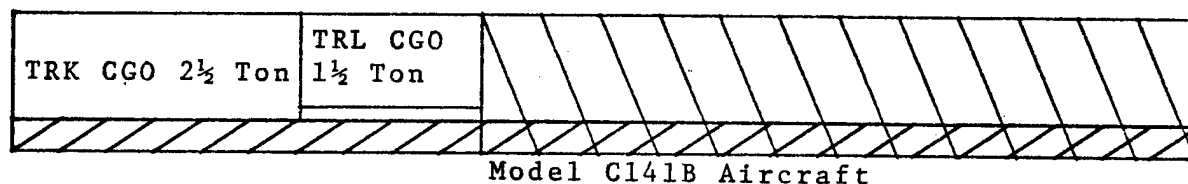


Model C141B Aircraft

The model then looks at the area represented by the two rectangles denoted as follows:



The model then attempts to load one of the remaining items of equipment into the area represented as rectangle 1 above. The width dimension of rectangle 1 (27.6 inches) is exceeded by the width of any of the remaining items of equipment; therefore, no equipment is loaded in this area. ASLM will then attempt to load one of the remaining items of equipment into the area represented as rectangle 2 above. This results in loading the TRL CGO 1 1/2 TON onto the C141B. Again, ASLM will search the remaining list of equipment and attempt to double row load an item of equipment parallel to the TRL CGO 1 1/2 TON. The critical width in this case becomes 40 inches (123 inches - 83 inches) and therefore no double row loading is possible. The results of loading the TRL CGO 1 1/2 TON onto the C141B (2d iteration) is as follows:

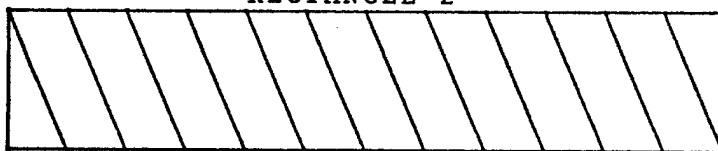


The model then looks at the areas represented by the rectangles denoted as follows:

RECTANGLE 1



RECTANGLE 2



It should be obvious that rectangle 1 above is identical to the rectangle 1 shown on page A-5. Furthermore, this rectangle will remain constant until an item of equipment is loaded whose width dimension exceeds the width of the TRK CGO 2 1/2 TON. The width of rectangle 1 is thus always defined by the residual width resulting from the widest item of equipment loaded on the aircraft. The length of rectangle 1 also remains constant unless the entire width of the aircraft is exhausted at some point in the loading process. ASLM continues to load remaining equipment using a similar procedure as outlined above. In actual loading, the model alternates priority of loading so that for each iteration it will always attempt to first load the rectangle that it last attempted to load on the previous iteration. For example, the model will first try A, then B, load item, try B, then A, etc. Using this procedure, the model continues to load remaining items of equipment onto the aircraft until either the ACL is reached or the remaining rectangular areas are too small to allow for the further loading of additional items of equipment. This leads to the following fully loaded aircraft:

TRK CGO 2½ Ton	TRL CGO 1½ Ton	TRK UTIL ¼ Ton	TRK UTIL ¼ Ton	TRK UTIL ¼ Ton	TRL CGO ¼ Ton	TRL CGO ¼ Ton
					TRL CGO ¼ Ton	

Model C141B Aircraft

A-6. SUMMARY: Given the TARGET-generated unit equipment file for a specified force, ASLM will first sort the data by length and then screen the data against the MTMC air certification data file to identify C5A required and C141B eligible equipment. Identified C5A required equipment will be loaded on the C5A and the C5A will be fully loaded to its ACL or cube limit with remaining unit equipment. ASLM will then begin loading unit equipment on the priority aircraft utilizing the procedures described in paragraph A-5 above. Each aircraft will be fully utilized to its maximum extent (either ACL or cube limitation is exhausted) prior to the scheduling of another aircraft. This process continues until all equipment appearing on the Unit Equipment File is

loaded on an aircraft. ASLM also generates and loads USAF 463L pallets for residual general cargo and accompanying supplies that cannot be transported in organic cargo carriers. Unit integrity is again maintained in generating pallet loads and loads are based on remaining weight and cube capacity (to include loading ramp) of each individual aircraft.

APPENDIX B
TYPE AIRMOBILE DIVISION

<u>Unit</u>	<u>SRC</u>	<u>Multiplier</u>
Division HHC	67004H100	1
MP Company	19017H720	1
Aviation Group	07200H100	1
Signal Battalion	11205H110	1
Engineer Battalion	05215H110	1
Brigade HHC	67042H110	3
Air Cavalry Squadron	17095H110	1
Division Artillery	06700H110	1
Division Support Command	29041H110	1
ADA Battalion	44435H010	1
Combat Intelligence Company	30019H630	1
NBC Defense Company	03087H700	1
Infantry Battalion	07055H110	9

APPENDIX C
TYPE INFANTRY DIVISION

<u>Unit</u>	<u>SRC</u>	<u>Multiplier</u>
Division HHC	07004H000	1
MP Company	19017H710	1
Signal Battalion	11035H000	1
Engineer Battalion	05155H710	1
Brigade HHC	07042H000	3
Division Artillery	06100H000	1
ADA Battalion	44325H000	1
Air Cavalry Division	17205H200	1
Division Support Command	29001H000	1
Combat Aviation Battalion	57055H320	1
NBC Defense Company	03087H700	1
CEWI Battalion	34165H810	1
Tank Battalion	17035H010	1
Infantry Battalion	07015H020	8
Infantry Battalion (MECH)	07045H030	1

APPENDIX D

TYPE MECHANIZED INFANTRY DIVISION

<u>Unit</u>	<u>SRC</u>	<u>Multiplier</u>
Division HHC	37004H000	1
MP Company	19017H710	1
Combat Aviation Battalion	17085H700	1
Signal Battalion	11035H000	1
Engineer Battalion	05145H710	1
Brigade HHC	37042H000	3
Armored Cavalry Squadron	17105H000	1
Division Artillery	06300H020	1
Division Support Command	29011H000	1
ADA Battalion	44325H000	1
NBC Defense Company	03087H700	1
CEWI Battalion	34165H820	1
Infantry Battalion (MECH)	07045H030	6
Tank Battalion	17035H010	5

APPENDIX E
TYPE AIRBORNE DIVISION

<u>Unit</u>	<u>SRC</u>	<u>Multiplier</u>
Division HHC	57004H300	1
Combat Aviation Battalion	57055H310	1
Engineer Battalion	05025H300	1
Signal Battalion	11215H300	1
Brigade HHC	57042H300	3
MP Company	19017H720	1
Armored Recon Battalion	17215H300	1
ADA Battalion	44425H100	1
Air Cavalry Squadron	17275H400	1
Division Artillery	06200H300	1
Division Support Command	29051H320	1
NBC Defense Company	03087H700	1
Antiarmor Company	07107H600	3
Infantry Battalion	07035H020	9
Combat Intelligence Company	30019H630	1

APPENDIX F
TYPE CORPS SUPPORT FORCE

<u>Unit</u>	<u>SRC</u>	<u>Multiplier</u>
HHC, Combat Aviation Battalion	01256H200	1
Corps Aviation Company	01127H100	1
Helicopter Company Assault Support	01258H000	1
HHC, Ammunition Battalion	09036H200	1
Ordnance Company Conventional Ammunition	09038H300	2
EOD Team	09520H4FA	1
Missile Maintenance Team	09550H3AA	1
QM Airdrop Supply Company	10407H300	1
Airdrop Equipment Repair and Support Company	10417H400	1
HHC, Corps Signal Brigade	11412H800	1
Corps Area Signal Battalion	11415H610	1
Signal Operations Battalion	11345G600	1
Signal Battalion, Airborne	11225H000	1
Signal Operations Company	11127G700	1
Signal System Engineer Contract Team	11500G8GT	1
Engineer Company Light Equipment	05054H300	1
Engineer Company Medium Girder Bridge	05074H400	1
Engineer Company Float Bridge	05078H200	1
HHC, Engineer Brigade	05101H610	1
Combat Engineer Battalion, Heavy	05115H300	2
Combat Engineer Battalion, Airborne	05195H500	1
Fire Fighting Team FA	05510H2FA	1
Fire Fighting Team FB	05510H2FB	3

<u>Unit</u>	<u>SRC</u>	<u>Multiplier</u>
Fire Fighting Team FC	05510H2FC	2
Engineer Equipment Operation Team	05520H6GH	1
Engineer Utility Team	05530H6HE	1
Engineer Terrain Team	05540H3IJ	1
HHB, ADA Group	44012H600	1
ADA Battery Improved Hawk	44247H220	2
HHB, FA Brigade	06401H200	1
FA Battalion, Lance	06595H400	1
FA Battalion 155mm Towed	06425H300	1
HHC, SF Group	31102H000	1
SF Battalion	31105H000	1
Service Company SF Group	31127H400	1
Signal Company SF Group	11257H400	1
Command and Control Team PSYOPS	33500H0AC	1
Command and Control Team PSYOPS	33500H0AB	1
HHD, MP Battalion	19076H400	1
MP Company	19077H420	4
CID Detachment	19620H8GC	1
MI Battalion	30005H200	1
MI Battalion	30025G700	2
Aerial Exploitation Battalion	30105T600	1
MI Operation Team	30500G8FC	1
HQ/Operations Company CEWI Group	30102T600	1
Army Security Agency Special Operations Detachment	32104H400	1
HHC, Airborne Corps	52002H420	1

<u>Unit</u>	<u>SRC</u>	<u>Multiplier</u>
HHC, COSCOM	54022H410	1
MMC, COSCOM Forward Deployed	54023H510	1
Field Service Company General Support Forward	29114H400	1
Maintenance Company Heavy Equipment General Support COSCOM	29137H200	1
General Supply Company	29118H100	1
Repair Parts Supply Company General Support	29119H510	1
HHD, Maintenance Battalion	29136H300	1
Maintenance Company Forward	29207H300	1
Maintenance Company Rear	29208H300	1
HHC, Supply and Service Battalion	29146H500	1
HHC, Support Group	29102H200	1
Supply and Service Company	29147G900	1
Data Processing Unit	29550T720	1
Support Team COMSEC Logistical	29640H7HB	1
HHD, Truck Battalion	55016H400	1
Transportation Car Company Airborne Corps	55019H220	1
Aircraft Maintenance Company	55457G600	1
Light Truck Company	55017H520	1
Medium Truck Company	55018H620	1
Movement Control Center	55006H000	1
Terminal Service Company	55117H500	1
Terminal Transfer Company	55118H710	1
Cargo Documentation Team	55560H46B	1
Transportation Contract Supervision Team	55560H4JD	1

<u>Unit</u>	<u>SRC</u>	<u>Multiplier</u>
HHC, Medical Brigade	08112H600	1
Combat Support Hospital	08123H000	1
Medical Ambulance Company	08127H410	1
Medical Clearing Company	08128H400	1
Medical Air Ambulance Company	08137H200	1
Medical Supply Operations and Maintenance Unit	08287H600	1
Entomology Service Team LA	08620H0LA	1
Dispensary	08620H00A	1
Air Ambulance Team	08660H0RA	1
Dental Service Detachment	08670G9HA	1
Veterinary Service Team JA	08680G9JA	1
HHD, P&A Battalion COSCOM	12066H220	1
Personnel Service Company	12067H550	1
Postal Service Team AD	12550H2AD	1
Postal Service Team AB	12560H2AB	1
Finance Service Team	14500H6AC	1
Public Information Team	45500H2FB	1
HHD, Civil Affairs Battalion	41500H2AC	1
Military History Detachment	20017H300	1
NBC Team JA	03500H2JA	1